

The Remanufactured All-Electric Transit Bus



The Ultimate in Emission & Waste Reduction
Built By Transit Bus Experts



ZEPS Bus

Complete Coach Works (CCW) is using the concept of remanufacturing a bus to reduce cost and the environmental impact of bus manufacturing. The ZEPS bus relies on the reuse-reduce-recycle philosophy and is the ultimate in sustainability.

CCW takes a previously used transit bus powered by a diesel engine and remanufactures it into a like-new condition with an all-electric powered drivetrain system. The process of remanufacturing improves the service life of the bus and avoids material waste.

The transformation of an old transit bus to like-new condition begins by dismantling the old bus to the chassis level. Diesel engine, transmission, radiator and belt driven accessories are removed from the bus and the differential is remanufactured to a taller gear ratio of 6.1 from the existing ratio of 5.4. Shock absorbers, air bags, tie rod ends, and wheel hubs are replaced with new parts. New composite flooring and seating, electric air compressor, power steering pump, HVAC system, and all LED interior and exterior lighting are installed. The bus is also equipped with low rolling resistance tires, which reduce road drag and improve the vehicle operating range.

The flexible drive system platform allows CCW to use any existing low or high floor bus body to remanufacture an all-electric transit bus, resulting in low cost and quick implementation of the bus.



Shown above is IndyGo's sixth of 21 purchased ZEPS buses from CCW. "The project is another opportunity to show the forward thinking and progressive work being done, creating more interest in public transportation," said Mike Birch, Chief Operating Officer at IndyGo.

ZEPS Specifications*



Length	40/35/30 ft.	Suspension	Air	Electric Drive	High Torque
Width	8.5 ft.	Power Steering	Electric/ Hydraulic	Range	150+ Miles**
Wheelchair	Ramp	Brakes	Air Brakes	Electrical	12/24 Volt
Passengers	37/32/25+ Standees	GVW	39,600 lbs.	Charge Power	40kW
Door	Air Operated Electric Option	Front Axle	14,600 lbs.	Charge Time	4 hours
Wheelbase	293 in.	RearAxle	25,000 lbs.	Battery Pack	311 kWh***
Fire Suppression	Yes	HVAC	Electric	**Mileage may vary based on driving conditions ***Lithium ion	

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The ZEPS powered remanufactured electric bus is the ultimate in eliminating environmental impact in the transit industry. Using an advanced lithium ion battery system and liquid cooled drive system, the ZEPS electric bus provides tremendous fuel and maintenance cost savings. The electric bus also provides excellent driving range, satisfying majority of transit routes on a single charge. Providing clean and noise-free transportation to everyone at affordable prices is now possible.

**base model meets most transit needs, upgrades are available for customers requiring greater range, power and availability.*

Remanufactured Bus: Rebuilt to Like-New Condition

The chassis frame and structure are remanufactured to like new condition and high quality paint and graphics are applied

Windows are rebuilt with new seals, latches and energy efficient glass or polycarbonate

Door systems are completely remanufactured and safety and interlock systems are upgraded to comply with current regulations



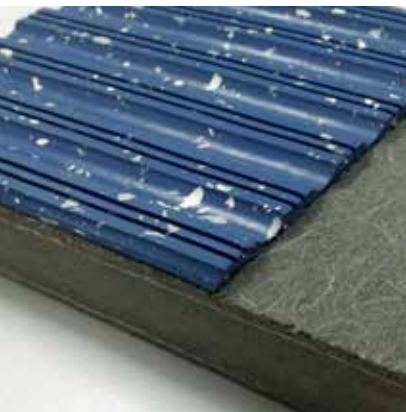
State-of-the-art all-electric propulsion system

New lightweight aluminum wheels & low rolling resistance tires are installed

New suspension, break pads, air bellows, wheel mounts, and steering wheel linkages are installed

Wheelchair ramps are rebuilt to new OEM specifications and the bus is updated to comply with current ADA regulations

SMART MATERIALS: Lightweight & Energy Efficient for Extended Range



Composite Light-Weight Flooring

Instead of using heavy marine grade plywood flooring, we utilize high-density polyurethane foam reinforced with layers of fiberglass. The no-rot and light-weight advantages of foam combined with the structural properties of fiberglass make these composite panels an excellent replacement material for wood. In addition, we also utilize light weight rubber flooring to reach a combined weight savings of over 600 pounds, while having stronger rot and corrosive resistance to the elements.



Energy-efficient LED Lighting

By utilizing LED Lighting throughout the bus we have cut down the lighting energy consumption by two-thirds. The life of a high-power white LED is projected to be from 35,000-50,000 hours, compared to 750-2,000 hours for an incandescent bulb. A conventional light bulb wastes most of its energy as heat. For example, an incandescent bulb gives off 90 percent of its energy as heat, while a compact fluorescent bulb wastes 80 percent of its energy. Since LED contain no glass components, they are not vulnerable to vibration or breakage like conventional bulbs.



All Electric Drive System

The ZEPS bus includes state-of-the-art inverter and motor technology. The system provides maximum torque at start and smooth acceleration profile. The High voltage distribution and DC-DC converters are integrated into a single box to reduce number of components and improve product reliability. The system operates at 350V DC giving perfect balance of safety and performance. The intelligent telemetry system collects all critical system parameters allowing remote monitoring and troubleshooting.



Intelligent Climate Control System

Intelligent Climate control system is critical for passenger comfort. The ZEPS bus provides intelligent climate control that maintains perfect internal temperature in all-weather conditions. The all-electric roof top mounted air conditioning system provides uniform cooling at all vehicle speeds and loads. The energy efficient system is twice as efficient as traditional water based cooling systems and is 50 percent lighter in weight.

Lightest & Most Energy Dense Battery Pack on the Market



ZEPS Drive System

- Built on proven American bus chassis
- Seamlessly integrated motor control system for an optimized transit application
- Charging system that actively balances batteries to maximize range and cycle life
- Parallel energy storage system that optimizes efficiency and reduces downtime

The remanufactured all-electric bus provides completely new interiors and customized color schemes to match your existing fleet. Light-weight composite flooring is more durable than plywood flooring. The flooring accompanied with efficient electric drivetrain essentially cuts total interior noise by half and completely eliminates noise when idle. Energy efficient windows help to maintain comfortable internal air temperature and all LED lighting provides a clear pleasant light for enhanced passenger comfort while reducing the energy load on the batteries. ZEPS is an ADA compliant bus and provides two wheel chair tie-in positions and safety belts.



ZEPS Benefits

Emissions Reduction Projections

According to the Argonne National Laboratory's GREET 1.8 fleet carbon footprint calculator, which calculates greenhouse gas emissions for vehicles, the amount of emissions eliminated using the ZEPS drive powered bus was determined. The table below, using the California Grid Energy source mix for calculations of emissions, compares emissions using different fuels and assumes 50,000 miles driven per year. The emissions for hydrogen fuel cell and electric bus are calculated using emissions caused by the generation of electricity used to generate hydrogen or charge the battery packs.

Bus Type	GHG emission (Short ton)/Year
Diesel	140.5
CNG	122.9
Diesel Hybrid	97
Hydrogen Fuel Cell	85
ZEPS All Electric	71
ZEPS Charged With Renewables	0

From the comparison table, it is evident that our all-electric transit bus provides a significant emission reduction. An all-electric bus coupled with 100% renewable energy generation can eliminate greenhouse gas emissions by 140 short tons per bus per year.

Fuel Cost Savings

Apart from the reduction in greenhouse gas emissions, an all-electric transit bus will also significantly reduce fuel costs. Using the EPA's MPG equivalent formula for electric vehicles, it is estimated that the ZEPS bus will provide MPG equivalent of 21.2, which is four times more efficient than conventional diesel buses. More efficient buses will result in lower fuel and maintenance costs. Overall lifecycle cost calculations show that the ZEPS bus will save more than \$340,000 in comparison to a diesel bus.

Maintenance Cost Saving

The annual maintenance cost savings were estimated by using several published reports by transit authorities. The cost of maintenance of the ZEPS bus will be almost one-fifth of the diesel powered bus. An all-electric bus will significantly improve the vehicle reliability, helping transit agencies to minimize the downtime between failures and improve service to communities.

Eliminating Waste Disposal

As the ZEPS bus does not require engine oil, transmission fluid, antifreeze, diesel particulate filters, urea injection, emission control equipment, oil filters, fuel filters and transmission filters, the cost of procuring such components and the environmental damage caused by disposal is eliminated. Recycling of the bus chassis also conserves valuable metal resources. A single ZEPS bus will conserve more than 10,000 pounds of ferrous metals. The activities related to mining, extraction and shipping of metals adds significant quantity of greenhouse gas emissions. By utilizing retired bus chassis, CCW is providing excellent value to its customers and also providing lowest total life cycle carbon emissions for a transit bus.

ZEPS Cost Savings

Cost Parameters	Diesel	Electric
Average Revenue Miles per year	47,450	47,450
Average Fuel mileage (Miles per gallon)/ (Miles per kWh)	4	.57
Fuel Cost per Unit (Gallon / kWh)	\$3.6	\$.12
Total Annual Cost of fuel	\$42,705	\$9,989
Fueler labor Average per vehicle (\$3.50) Annual fueler labor costs per Vehicle	\$1,085	\$ -
Engine Oil costs per quart (\$2.15) annual oil costs per vehicle	\$378	\$ -
Transmission Fluid \$5.69 Quart annual ATF cost based on two yearly services	\$273	\$ -
Brake replacement Costs Front Parts and Labor (50,000 miles for Diesel, 100,000 miles for electric)	\$2,110	\$1,055
Engine replacement cost-Engine life cycle 250-300 thousand Miles	\$18,000	\$ -
Transmission rebuild cost – Voith transmission life cycle 500 thousand miles	\$12,000	\$ -
Diesel Filter, Fuel Filter, Transmission Fluid filter replacement	\$1,125	\$ -
PM Filter cleaning	\$500	\$ -
Filter & Oil Disposal	\$2,000	\$ -
12 Year Life cycle cost calculations		
Fuel cost	\$512,460	\$119,874
Labor for fueling	\$13,020	\$ -
Engine oil change	\$4,541	\$ -
Transmission fluid change	\$3,278	\$ -
Brake replacement	\$25,320	\$12,660
Filter procurement, cleaning and disposal	\$43,500	\$ -
Total Fuel and Lubricants	\$602,118	\$132,534
Total of hard parts repair or replacement (engine, Transmission)	\$30,000	\$5,000
Total labor costs to replace engine and Transmission	\$6,160	\$1,500
Total for hard parts, fuel, oil, ATF, and labor connected with fossil fuel	\$638,278	\$139,034
Midlife upgrade after 6 years (Engine/ Battery pack)	\$30,000	\$108,850
Diesel Particulate Filter Retrofit	\$15,000	\$ -
Overall Life Cycle cost for the bus	\$683,278	\$247,884
Total Lifetime cost savings	NA	\$435,395

ZEPS Drive System = ↗
Big Savings \$\$\$

Faster pay-back, lower up-front cost, smallest carbon footprint,
faster execution and unmatched performance make the ZEPS buses
A SMART CHOICE.



800-300-3751

zepsdrive.com

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